3E1101

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B. Tech. III - Sem. (Main) Exam., Dec. - 2018
BSC Aeronautical Engineering
3AN2 – 01 Advanced Engineering Mathematics - I
AE, AG, AN, CE, EC, EI, ME, MH, MI

Time: 3 Hours

Maximum Marks: 120

Instructions to Candidates:

Attempt all ten questions from Part A, five questions out of seven from Part B and four questions out of five from Part C.

Schematic diagrams must be shown wherever necessary. Any data you feel missing may suitably be assumed and stated clearly. Units of quantities used /calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

205

1. NIL
2. NIL

PART – A

(Answer should be given up to 25 words only) **[10×2=20]**

All questions are compulsory

Q.1 Construct the forward difference table for the function $f(x) = \tan x$ for $0.10 \leq x \leq 0.30$ by taking $h = 0.5$.

Q.2 Prove that $E = e^{hD}$, where symbols have their usual meanings.

Q.3 Write Gauss forward and Gauss backward interpolation formula.

Q.4 What is numerical integration formula in Simpson's 3/8 rule?

Q.5 Using Runge – Kutta second order method, the approximate solution of the differential equation $\frac{dy}{dx} = f(x, y);\ y(x_0) = y_0$ is given by

$y_{n+1} = y_n + 2\alpha(k_1 + k_2)$, where $k_1 = hf(x_n, y_n)$ and $k_2 = hf(x_n + \beta h, y_n + \gamma k_1)$. Then what are the values α, β, γ?

Q.6 State existence condition of Laplace Transform.

Q.7 Find Laplace transform of $b^x f(ax)$.

Q.8 State convolution theorem for Fourier transforms.

Q.9 Write damping rule for z – transform.

Q.10 Write a function whose z– transform is equal to 1.

PART – B

(Analytical/Problem solving questions) **[5×8=40]**

Attempt any five questions

Q.1 Prove that

$$u_1 x + u_2 x^2 + u_3 x^3 + \cdots = \frac{x}{1-x} u_1 + \left(\frac{x}{1-x}\right)^2 \Delta u_1 + \left(\frac{x}{1-x}\right)^3 \Delta^2 u_1 + \cdots$$

Q.2 Using Lagrange's interpolation formula, find the value of $\log_{10} 301$ for the following data –

	x_0	x_1	x_2	x_3
x	300	304	305	307
$\log_{10} x = f(x)$	2.477	2.482	2.484	2.4871

Q.3 Evaluate $\sqrt{28}$ to 4 decimal places by Newton – Raphson method.

Q.4 Using Runge – Kutta method, obtain a solution of the equation

$$\frac{dy}{dx} = xy; y(1) = 2$$

for x = 1.4, using h = 0.2.

Q.5 Define Dirac Delta Function and find its Laplace and Fourier transforms.

Q.6 Find the Fourier transform of $f(x)$ defined by –

$$f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$$

And hence evaluate $\int_{-\infty}^{\infty} \frac{\sin sa \cos x}{s} ds$.

Q.7 Using convolution theorem, evaluate

$$Z^{-1}\left\{\frac{z^2}{[illegible]}\right\}.$$

PART – C

(Descriptive/Analytical/Problem Solving/Design Questions) [4×15=60]

Attempt any four questions

Q.1 (a) Find inverse Laplace transform of $s \log\left(\frac{s-1}{s+1}\right) + 2$.

(2) (b) Using Newton – Gregory forward formula, find interpolation polynomial, which passes through the points (1, -1), (2, -1), (3, 1) and (4, 5).

Q.2 (a) Given that $\frac{dy}{dx} = \frac{1}{2}(1 + x^2)y^2$ and $y(0) = 1$, $y(0.1) = 1.06$, $y(0.2) = 1.12$, $y(0.3) = 1.21$. Evaluate $y(0.4)$ by Milne's predictor method.

(b) Find the value of $\log_e 2$ from $\int_0^1 \frac{x^2}{1+x^3}\,dx$. using Simpson's $\frac{1}{3}$ rule by dividing the range into five ordinates.

Q.3 (a) Use Laplace transform theory to solve the initial value problem

$\frac{dy}{dt} + y = f(t),\ y(0) = 2$, where $f(t) = \begin{cases} 0, & 0 \le t < \pi/2 \\ \cos t, & t \ge \pi/2 \end{cases}$

(b) Use Stirling formula to find y_{28} given:

$y_{20} = 49225,\ y_{25} = 48316,\ y_{30} = 47236,\ y_{35} = 45926,\ y_{40} = 44306.$

Q.4 (a) Find the complex Fourier transforms of $e^{-|x|}$.

(b) Using Regula Falsi method find real root of equation $x^2 + 4 \sin x = 0$.

Q.5 (a) Find f(x) if its Fourier cosine transform is $\frac{1}{1+s^2}$.

(b) Using Z – transform solve the difference equation $6u_{n+2} - u_{n+1} - u_n = 0$, given that $u(0) = 0,\ u(1) = 1$.